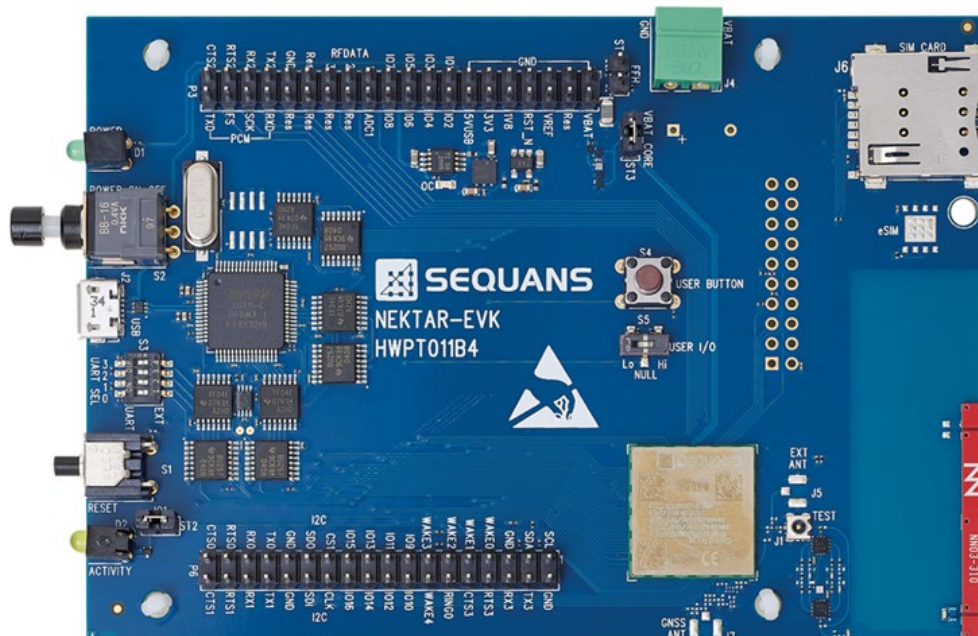ignion⋏⋏

Versatile, multiband mini-antenna for Sequans' NEKTAR-B

APPLICATION NOTE
TRIO mXTEND™ (NN03-310)

WORLDWIDE CELLULAR CONNECTIVITY EVALUATION KIT WITH MULTIBAND EMBEDDED ANTENNA

- **Frequency regions:** 617-960 MHz and 1695-2200 MHz

Sequans NEKTAR-B Evaluation Kit – Covers all the cellular IoT worldwide bands by embedding the TRIO mXTEND™ antenna component and the Monarch 2 GM02S LTE Cat M1/NB1/NB2 module.

The new NEKTAR-B Evaluation Kit by Sequans helps any designer to develop any IoT next application in a short period of time. The reference design integrates an ultra slim and multiband chip antenna component to cover worldwide cellular connectivity.

The embedded antenna is connected to the RF transceiver through a matching network that shapes the frequency response of the wireless platform and enables **worldwide connectivity from 617 MHz up to 2200 MHz**.

The cellular IoT antenna embedded into the NEKTAR-B is an example of the new generation of antenna components available for top multiband connectivity. **Going from a NEKTAR-B prototype to a final product does not require changing the antenna part anymore**, the same off-the-shelf standard component will fit any of your final devices with just an electronic adjustment.

With Sequans' NEKTAR-B **NB-IoT/LTE-M cellular prototyping platform, you can** design your next IoT device design without the need to build the whole hardware from the beginning. Cover any global range and create a multitude of final products including utility meters, industrial sensors, asset trackers, and numerous additional smart home and smart city devices.

TABLE OF CONTENTS

1. TRIO mXTEND™ ANTENNA COMPONENT & MONARCH 2 GM02S PRODUCTS

TRIO mXTEND™ NN03-310

Monarch 2 GM02S
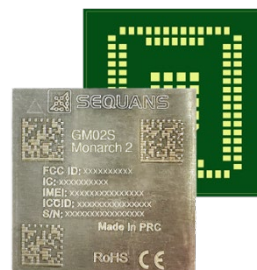
Dimensions: 30.0 mm x 3.0 mm x 1.0 mm

Dimensions: 16.3 mm x 17.0 mm x 1.85 mm

The **TRIO mXTEND™ chip antenna component** (NN03-310) has been specifically designed for providing the major level of flexibility to operate any required frequency band inside any wireless device.

TRIO mXTEND™ can be used in its **single port or multiport configuration**. Several radios can be allocated inside the same antenna component when used in its multiport configuration, thus allowing its operation in a great variety of communication standards through the same single antenna piece. This modular design **reduces considerably the integration complexity while saving cost, time and space.**

TRIO mXTEND™ chip antenna component not only offers the versatility of being used in a single port or multiport configuration, but also offers the flexibility to be **tuned at the frequency regions of interest through just the proper adjustment of the matching network**. This characteristic provides an important benefit since it allows designers to easily adapt the antenna performance to the different device requirements, constraints, or environmental conditions without the need of changing the antenna component.

The Monarch 2 GM02S module is an LTE Cat M1/NB1/NB2 module based on Sequans' second generation Monarch 2 chip platform. The Monarch 2 GM02S is a total module solution, including a complete, Single SKU™ RF front end for deployment in the integration of the SIM inside the module with zero compromise on security while **lowering cost and reducing complexity**. The GM02S is part of Sequans next generation "S" family of modules, featuring a very small yest cost-effective form factor that requires no external components.

Monarch 2 GM02S leverages Sequans' 15-plus years of experience in 4G and 5G technologies and incorporates Sequans' carrier-proven LTE protocol stack and a software suite that is one of the most mature in the industry. The Monarch 2 GM02S inherits Monarch's already **certified LTE-M and NB-IoT stack** and delivers the significantly improved performance and lower power consumption enabled by Sequans' second generation Monarch 2 chip and the new module architecture.

2. NEKTAR-B

A device example of the architecture explained in this application note is NEKTAR-B Evaluation Kit. It integrates the Monarch 2 GM02S module, supporting LTE-M and NB-IoT applications.

Two expansion connectors, NEKTAR CONNEKT, are placed on the NEKTAR-B board allowing to the hardware designers to connect external peripherals for prototyping purposes.
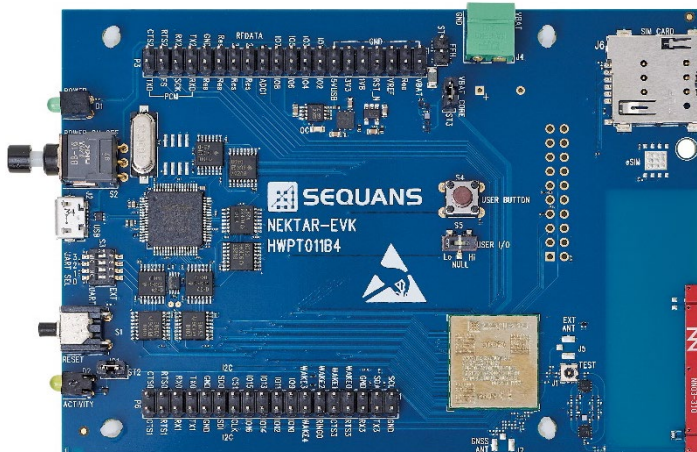
APPLICATIONS

- Industrial sensors
- Utility meters
- Asset trackers
- Health and fitness
- Smart home
- Smart city
- Wearable applications

It has the TRIO mXTEND™ chip antenna component for LTE-M, NB-IoT connected to the Monarch 2 GM02S module, supporting a global range of LTE bands enabling worldwide coverage, such as GSM850, GSM900, GSM1800/DCS, GSM1900/PCS, UMTS, LTE600, LTE700, LTE800, LTE850, LTE900, LTE1700, LTE1800, LTE1900, LTE2000 and LTE2100, (617-960MHz and 1710-2200MHz).

3. TRIO mXTEND™ & MONARCH 2 GM02S LTE-M/NB-IOT MODULE ENABLING NEXT-GENERATION IOT

3.1. LAYOUT RECOMMENDATIONS

On its starter configuration, NEKTAR-B has been optimized following these general guidelines and recommendations (Figure 1):

- Minimum recommended PCB size: 130 mm x 80 mm.
- At least one continuous ground plane layer in at least on PCB layer.
- Place the TRIO mXTEND™ chip antenna component close to a corner of the PCB.
- Include a feeding line 1mm width as close to the corner as possible.
- Leave a ground clearance (area free of any component or conductive traces) of at least 47 mm x 17 mm. This clearance area applies to all layers.
- Include the Monarch 2 GM02S module from Sequans close to the antenna matching network layout.

- Include pads compatible with 0201 SMD components for the LTE matching networks as close as possible to the feeding point (see next section for details about the matching network).
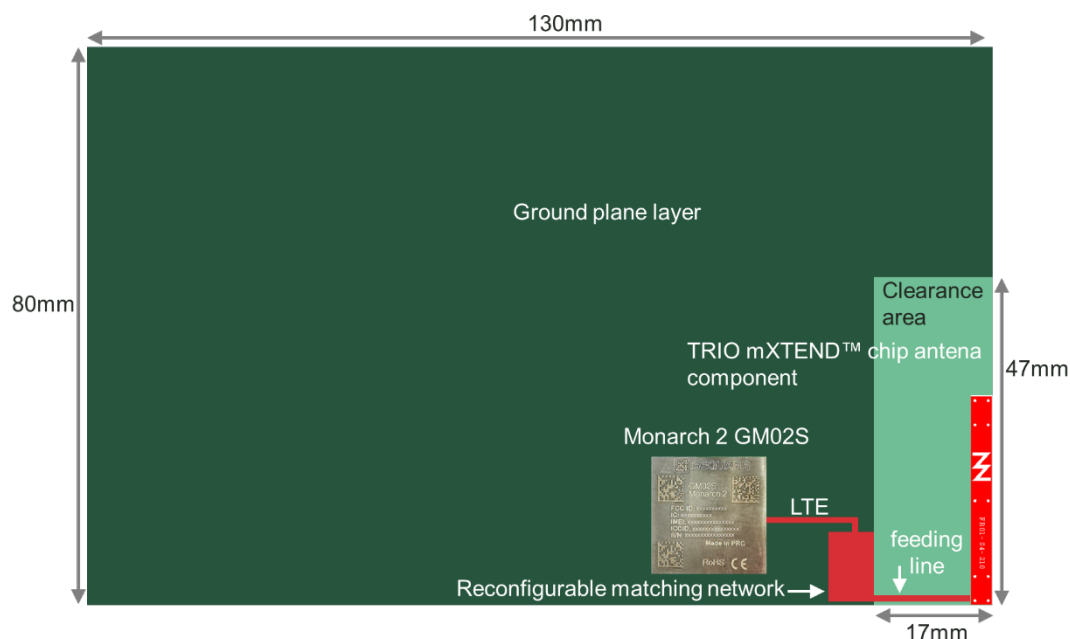

Figure 1 – Layout recommendations

If you need assistance to design your matching network beyond this application note, please contact support@ignion.io, or if you are designing a **different device size** or a **different frequency band**, **we can assist you** in less than 24 hours. Please, try our free-of-charge[1] Antenna Intelligence Cloud, which will get you a complete design report including a custom matching network for your device in 24h[1]. Additional information related to NN's range of R&D services is available at: https://ignion.io/rdservices/

3.2. ELECTRICAL SCHEME TO CONNECT TRIO mXTEND™ CHIP ANTENNA COMPONENT AND MONARCH 2 GM02S LTE-M/NB-IOT MODULE

A reconfigurable matching scheme combining the TRIO mXTEND™ chip antenna component, the Monarch 2 GM02S LTE Cat M/NB_1/NB_2 module and the SKY13414-485LF from Skyworks enables operation at LTE bands (617MHz up to 2200MHz) (Figure 2).

With this architecture, designers have the freedom to individually optimize their matching networks into their devices and eventually upgrade their designs always including an optimized solution for any possible platform. (Figure 4).

---

[1] See terms and conditions for a free Antenna Intelligence Cloud service in 24h at: https://www.ignion.io/antenna-intelligence/
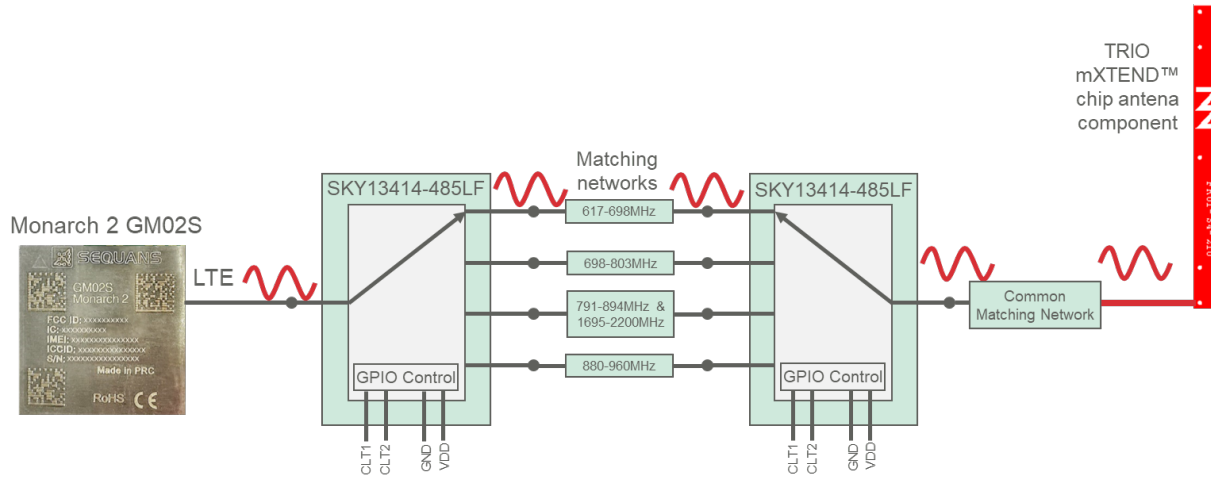
Figure 2 – Scheme for connecting TRIO mXTEND™ chip antenna component and Monarch 2 GM02S

The cellular frequency band of operation is automatically controlled by the Monarch 2 GM02S through a GPIO interface. Such interface controls the Skyworks SKY13414-485LF switches with two control lines (CLT1-2). In this application note, five matching networks designed with the NI-AWR software are used, one matching network common for all the bands and four individual matching networks used to match different bands of LTE. The same matching network topology using 0201 SMD components is employed for the matching network section associated to each band (Figure 3)(Figure 4) – (Table 1).
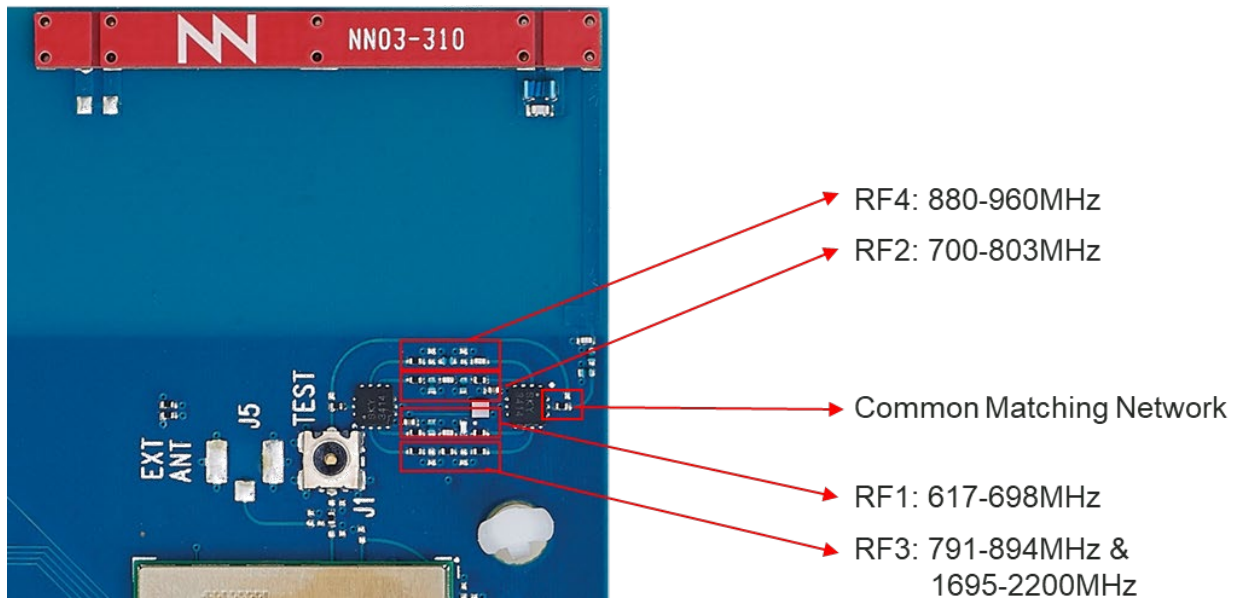
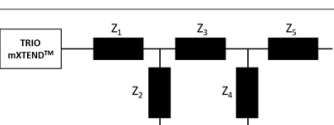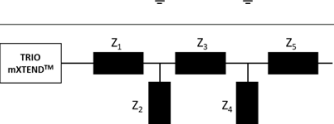**Figure 3 –** Matching networks placement on the NEKTAR-B Evaluation Kit.
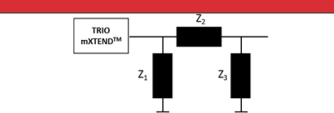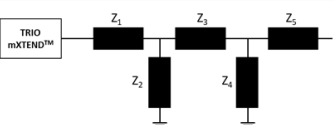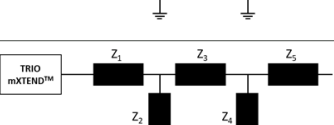
STATE	Frequency band	Matching Network			
-	Common Matching Network		Component	Value	Part Number
			Z1	0.4 pF	GJM0334C1HR40WB01
			Z2	5.1 nH	LQW03AW5N1J00
			Z3	12 nH	LQW03AW12NJ00
RF1	617-698MHz		Component	Value	Part Number
			Z1	0Ω Resistor	-
			Z2	15 nH	LQP03HQ15NH02
			Z3	2.7 pF	GJM0333C1E2R7WB01
			Z4	8.7 nH	LQW03AW8N7J00
			Z5	0Ω Resistor	-
RF2	698-803MHz & 1695-2200MHz		Component	Value	Part Number
			Z1	0Ω	-
			Z2	10 nH	LQW03AW10NJ00
			Z3	3.2 pF	GJM0335C1E3R2WB01
			Z4	12 nH	LQW03AW12NJ00
			Z5	0Ω	-
RF3	791-894MHz & 1695-2200MHz		Component	Value	Part Number
			Z1	0Ω	-
			Z2	Open circuit	-
			Z3	0Ω	-
			Z4	Open circuit	-
			Z5	0Ω	-
RF4	880-960 MHz & 1695-2200MHz		Component	Value	Part Number
			Z1	3.2 pF	GJM0335C1E3R2WB01
			Z2	Open circuit	-
			Z3	2.9 nH	LQW03AW2N9C00
			Z4	Open circuit	-
			Z5	0Ω	-

Figure 4 – Matching networks for LTE used in the electric scheme shown in Figure 2

Technical features	617 – 698 MHz	698-803 MHz	791-894 MHz	880-960 MHz	1695-2220 MHz
Average Efficiency	- [2]	35.7%	48.7%	48.3%	54.5%
VSWR	< 3.2:1				
Radiation Pattern	Omnidirectional				
Polarization	Linear				
Weight (approx.)	0.25 g				
Temperature	-40 to + 125 ºC				
Impedance	50 Ω				

Table 1 – Technical features measured in NEKTAR-B Evaluation Kit (Figure 5)

---

[2] Value not measurable in our lab equipment
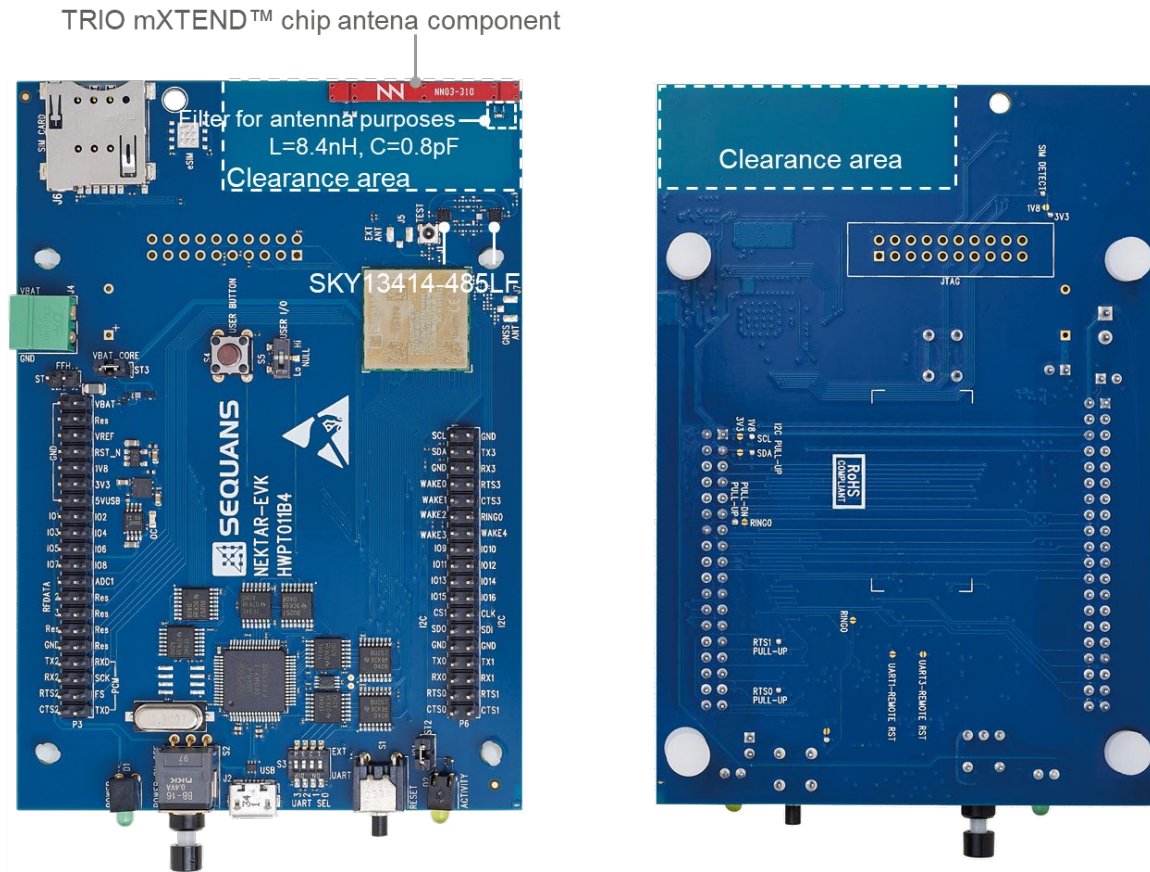
Figure 5 – Details of the clearance area, antenna, Monarch 2 GM02S and switches location on a PCB

4. DESIGN RECOMMENDATIONS FOR ANTENNA INTEGRATION

This section is intended to provide design recommendations to preserve the antenna performance when integrated in your device.

1. **Antenna placement**: Place the TRIO mXTEND™ (NN03-310) chip antenna component as close as possible to a PCB corner aligned with the longest side of the PCB. On the other hand, place the antenna as far as possible from other components, such as LCDs, batteries, connectors, especially those components and covers with metallic characteristics (see suitable placement in Figure 1).

2. **Clearance Area:** Keep the clearance area around the antenna component as recommended in the present report. The clearance area must be free from electronic components, traces and ground plane in all PCB layers including the underside of the PCB directly underneath the mounted antenna area. As a general rule of thumb, the larger the clearance area the better the performance.

3. **PCB layers**: Ensure a continuous ground plane layer in at least one layer of your PCB design. Avoid any ground plane or conductive trace underneath the matching network pads area at a distance shorter than 1 mm from it.

4. **Matching Network**: Arrange pads for all the matching networks to host 0402/0603 SMD components if possible. Place pads as close as possible to the antenna feed point and within the ground plane area to enable an effective tuning of the matching networks components throughout your design. The matching network for each band might need retuning as other elements of your device are placed around the antenna or the RF Switch model changes from the recommended one. Use preferably **high Q and tight tolerance** matching network components.

5. **Transmission line and RF Chip**: Design your transmission line connecting one of the RF switches output to your RF chip (see scheme connecting in Figure 2) so that its characteristic impedance is 50Ω. The output impedance of your RF chip must feature 50Ω as well. Locate your RF chip as close as possible to the matching network in order to reduce the losses introduced by the transmission line.

To follow these design recommendations will make the design experience and certification process of the IoT device much smoother and easier.

5. PRODUCT CHANGE NOTIFICATION
This document is property of Ignion,
Not to disclose or copy without prior written consent

PCN Number: NN19100013

Notification Date: October 07th, 2019

Part Number identification:

Part Number changes, it will be applied in all the document of the company (User Manual, Data Sheet, …)

Previous Part Number	New Part Number
FR01-S4-210	NN03-310

Reason for change:

☐	Specs (electrical/mechanical)	☐	Manufacturing location
☐	User Manual/Data Sheet	☐	Quality/Reliability
☐	Material/Composition	☐	Logistics
☐	Processing/Manufacturing	X	Other: Part Number

Change description

1.- Part Number: From FR01-S4-210 FRACTUS to NN03-310 Ignion in the User Manual

OLD   NEW

Comments:

1.- Electrical and Mechanical specs remain the same

2.- Footprint in the PCB to solder the chip antenna remains the same

Identification method

1.- The part number on the antenna is different

User Manual	X	Available from: January 2020
Samples	X	Available from: January 2020

Ignion Contact:

	Sales	Supply Chain
Name:	Josep Portabella	Albert Vidal
Email:	josep.portabella@ignion.io	albert.vidal@ignion.io

Do you need more help with your antenna for your device?

Use our **Antenna Intelligence Cloud service** and get your ready-to-test antenna design approach specially thought for your platform **free of charge**[1] and in **24 hours**.

https://www.ignion.io/antenna-intelligence/

The TRIO mXTEND™ chip antenna component and other Ignion products based on its proprietary Virtual Antenna™ technology are protected by one or more of the following Ignion patents.

All information contained within this document is property of Ignion and is subject to change without prior notice. Information is provided "as is" and without warranties. It is prohibited to copy or reproduce this information without prior approval.

Ignion is an ISO 9001:2015 certified company. All our antennas are lead-free and RoHS and REACH compliant.

ISO 9001: 2015 Certified

ignion

**Your innovation.
Accelerated.**

Contact:
support@ignion.io
+34 935 660 710

Barcelona

Av. Alcalde Barnils, 64-68 Modul C, 3a pl.
Sant Cugat del Vallés
08174 Barcelona
Spain

Shanghai

Shanghai Bund Centre
18/F Bund Centre, 222 Yan'an Road East,
Huangpu District
Shanghai, 200002
China

New Dehli

New Delhi, Red Fort Capital Parsvnath Towers
Bhai Veer Singh Marg, Gole Market,
New Delhi, 110001
India

Tampa

8875 Hidden River Parkway
Suite 300
Tampa, FL 33637
USA